Lake Effect Snow Flow-Chart

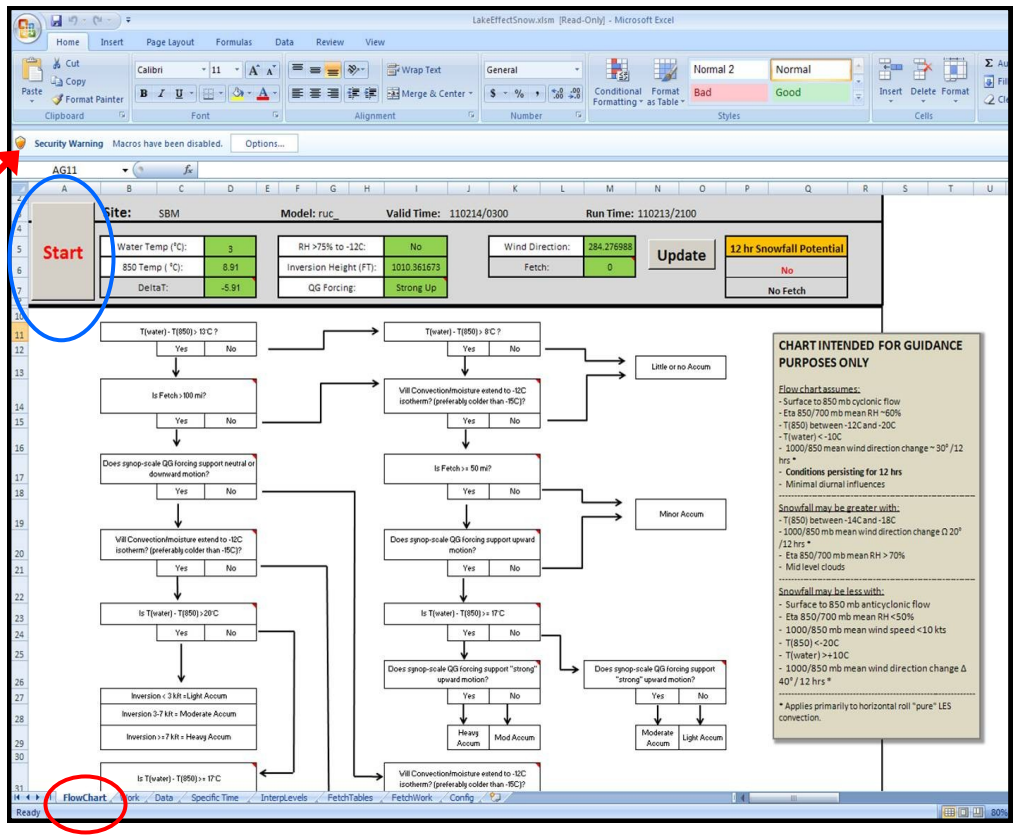
This automated flow-chart utilizes the flow chart template developed by the Gaylord, MI WFO for lake effect snow (LES) accumulation guidance by importing forecast data from Bufkit forecast profiles. This document will step the user through the process of running the flow chart. It will also discuss how the parameters are retrieved and/or calculated. The final section will explain how to customize the spreadsheet for each office.

Using the Program:

Please note: Some setup is required before the first use per office or computer. See the configuration section of this document.

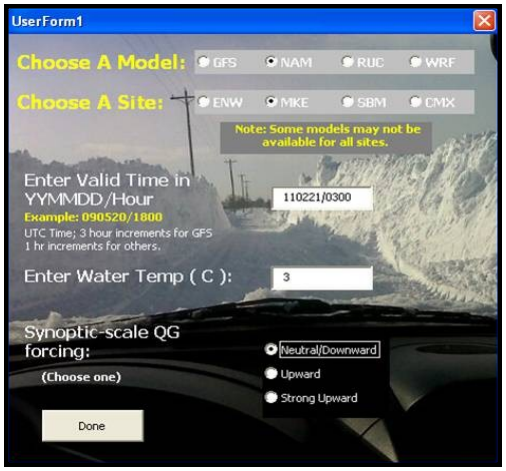
The content of the spreadsheet is primarily found on the FlowChart tab. This should be what is first displayed when the spreadsheet is opened. If you do not see this, be sure the FlowChart tab is selected at the bottom of the Excel window. (Red circle in image below).

The first thing that must be checked is to verify that macros and data connections are enabled. If there is a Security Warning at the top of your Excel window, select the options button and enable the items that pop up. If there is no security warning, macros are likely already enabled.



Now you're ready to start. Hit the Start button in the upper left. (Blue circle)

If after clicking the start button, an error comes up, please see the troubleshooting section at the end of this document. For possible solutions.



The form to the left should pop up after the Start button is selected. The fields will be empty.

- Select a model and a site from the radio buttons at the top. Note that the models available are the ones that are downloaded on your computer or server. Generally, the model/site combinations that are available to you in Bufkit will be the ones you can choose on the form.
- Next enter the forecast hour you are interested in using the date/time format listed.
- Enter the water temperature of the lake.
- Choose the qg forcing term that best describes the situation.

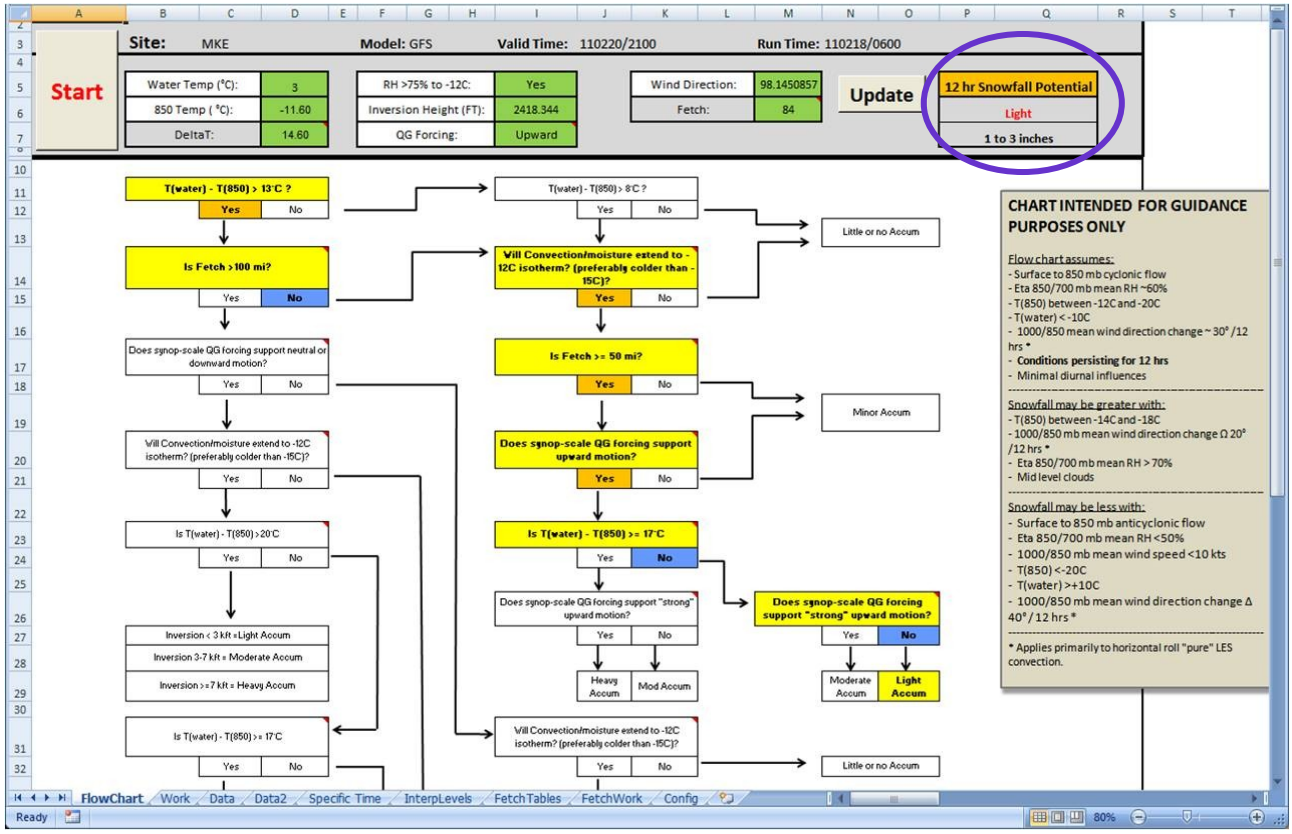
Hit the Done button.

The program will take approximately 10 seconds to pull the data and move some numbers around. During this time, you may see it jump between windows a bit. If Bufkit profiles are being requested from the PSU FTP site, a window may pop up for logging into the FTP server. If you see that window, just hit OK as it is set to use "anonymous:.

If it worked correctly, it should take you back to the FlowChart tab at the end.

The first-guess solution based on the Bufkit forecast profile and the user input information will be displayed.
If no cells in the flow chart are colored on your screen, the most likely reason is that the wind direction resulted in no fetch at the location. In that case, the Snowfall Potential result box (Purple circle on below image) would say No and No Fetch.

The highlighted path through the flowchart relates to the values in the boxes above that have been pulled from the Bufkit data. The result will be displayed in the upper right corner.



It is important to remember that the data returned in this spreadsheet is based strictly on the forecast data for one point in time and in space chosen in the start up. It can not see the conditions out over the lake or anywhere else in the area.

The conditions in the green boxes may be edited by the user. If you disagree with the values that are populated, or want to test out some variables that other models may be showing differently, feel free to change the values in the green boxes….with two exceptions. You should not need to change DeltaT because it is calculated from the water temp and 850 temp. If you want another value there, please change either water or 850 temp accordingly. Also the Fetch cell is referencing another location, so it would be best to not change that value. Instead, change the wind direction to whatever you think it will actually be, and the fetch will be entered from tables built into the program. The one time that you may need to change the Fetch manually is if there is ice coverage on the lake and you need a shorter fetch than the standard distance across the lake. This is fine. Next time you run the program from the Start button, the fetch will revert to being tied to the wind direction.

If you change values in the green boxes, click on the Update button to view the new solution.

How the data is calculated:

Bufkit data files include a finite number of pressure levels and the conditions at those levels. To most accurately find the required data for this flow chart, a linear interpolation is been performed between pressure levels to retrieve the conditions for ever 1mb. This data is then used in the parameters as described below.

- **Water Temp:** User Input.

- **850 Temp:** Straight from linear interpolated data, this is the value of temperature in degrees C at the 850 mb level.

- **Delta T:** Simply uses an equation to find the difference in degrees C between Water Temp and 850 Temp.

- **RH to –12C:** Beginning at the surface level, the program checks with increasing height to the first point when the temperature reaches –12C. Temperature and dewpoint for all levels below this first –12C level are examined for relative humidity. If every level has RH above 75%, a yes is returned. If not, a no is returned.

- **Inversion Height:** This is one of the more difficult...and potentially problematic variables. Currently the chart is incorporating a method described by Evans and Murphy (WFO BGM) in a 2008 paper. http://www.nwas.org/ej/2008-EJ2/.

  Define ΔT as the temperature at the current level subtracted from the temperature at the next level above the current level in the BUFR data. For example, if temperature increases with height, ΔT is positive.
  Start sampling at the level closest to 950 hPa and repeat the following at every level until an inversion is defined, or until you reach the level closest to 850 hPa.
  If ΔT >= 0 set this as your inversion level.
  If ΔT < 0 but > - 0.4 then check the value of the dew point depression.
  If the dew point depression >= 5C, then set this as your inversion level.
  If ΔT <= -0.4, you have no inversion
  If no inversion has been defined by the time you have sampled up to 850 hPa, do the following at each layer until you define an inversion, or until you reach the layer closes to 500 hPa.
  If the dew point depression >= 5C then set this as your inversion level.
  If delta T > -0.8 set this as your inversion level.
  If no subsidence inversion level has been defined before reaching 500 hPa, set the inversion level at 500 hPa.

  This procedure may be updated in the future.

- **QG Forcing:** User Input.

- **Wind Direction:** This is the mean sfc to 850mb wind direction. The wind at every pressure level from the surface to 850mb is split into u and v components, averaged and then converted back into speed (KTS) and direction.

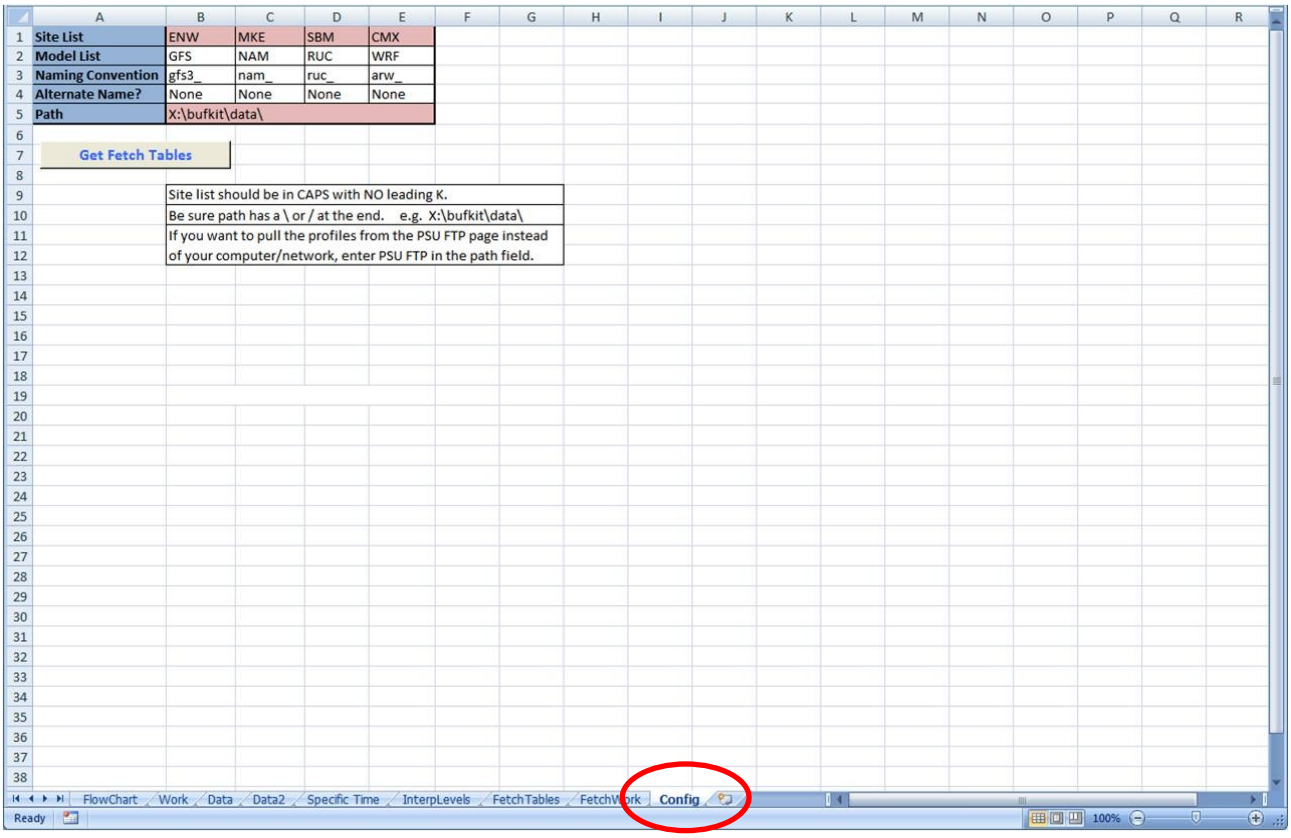
- **Fetch:** The fetch values are dependent on the sfc to 850mb mean wind direction. The value is determined from tables that have been manually developed by measuring the distance in miles across the lake every 10 degrees.

Customizing:

Customizing for general purposes has been made as simple as possible utilizing a configuration page.

First save the workbook to a location on your computer or network. Be sure the name of the file is LakeEffectSnow.

Open the file and choose the Config tab at the bottom of the worksheet.



Sites: You can specify up to 4 sites to have available for users to select. The sites should be entered in cells B1, C1, D1 and E1with **3-letter** identifier and in **capital letters**. If you don't need 4 sites, leave the other cells blank.

Models: At this time, the only model options are GFS, NAM, RUC and some WRF models . Others may be added, but because the formatting of the Bufkit file varies with different models, it will take some additional work by the developer or someone at your office who is familiar with Visual Basic programming in Excel macros. Formatting for WRF files may also vary by office. If yours does not work correctly contact the developer to see if adjustments are possible to make it work.

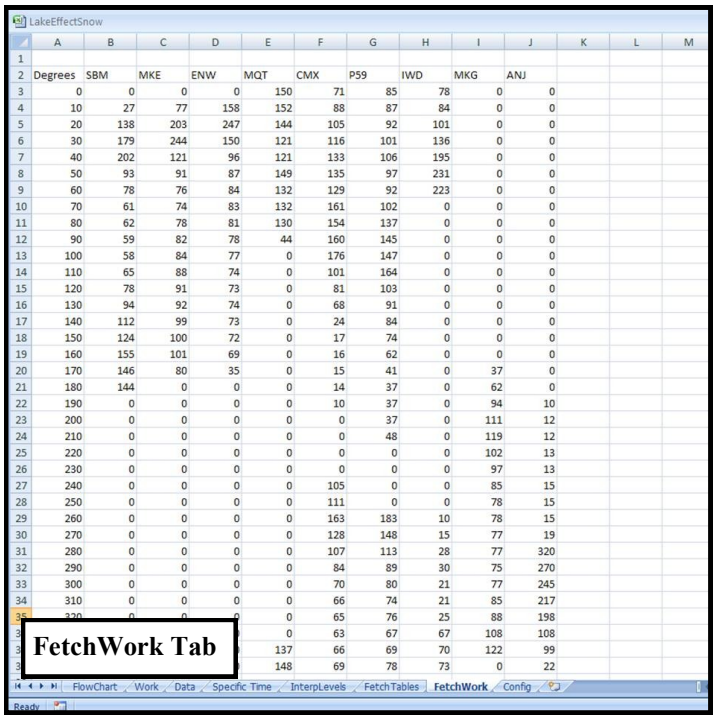
Naming Convention: Because not all offices use the same identifier for each model, it is necessary to enter specific names here. The PSU FTP site and many offices use the default conventions for the 3 main models (gfs3_, nam, and ruc).

Alternate Name: If certain model runs are named differently from others (ie, 06/18z runs have one name while 00/12z have another) enter the name of the second file in the alternate name line. If all runs use the same name, enter "None" as the alternate name.

Path: Edit the path in cell B5 to show the location where Bufkit files are stored on your computer or network. Be sure to include the trailing \ to indicate this is a directory containing files. If you do not have Bufkit files downloaded, they can also be retrieved from the Penn State University FTP page. If you choose to use this site, just enter PSU FTP in cell B3 for the path. Note that the first time you run off the PSU FTP site, you'll get a pop up login box. Just select ok with Anon highlighted.

Info for setting up fetch tables is on the next page.

Fetch: This is the one thing that takes a little work to set up. There are a few fetch tables already done in the Fetch-Work tab. If the ones you want are not there, you will need to get the values and build this table yourself, adding it in the first empty column. It should only take 10 minutes to do for each site once you start.



Degrees	SBM	MKE	ENW	MQT	CMX	P59	IWD	MKG	ANJ
0	0	0	0	150	71	85	78	0	0
10	27	77	158	152	88	87	84	0	0
20	138	203	247	144	105	92	101	0	0
30	179	244	150	121	116	101	136	0	0
40	202	121	96	121	133	106	195	0	0
50	93	91	87	149	135	97	231	0	0
60	78	76	84	132	129	92	223	0	0
70	61	74	83	132	161	102	0	0	0
80	62	78	81	130	154	137	0	0	0
90	59	82	78	44	160	145	0	0	0
100	58	84	77	0	176	147	0	0	0
110	65	88	74	0	101	164	0	0	0
120	78	91	73	0	81	103	0	0	0
130	94	92	74	0	68	91	0	0	0
140	112	99	73	0	24	84	0	0	0
150	124	100	72	0	17	74	0	0	0
160	155	101	69	0	16	62	0	0	0
170	146	80	35	0	15	41	0	37	0
180	144	0	0	0	14	37	0	62	0
190	0	0	0	0	10	37	0	94	10
200	0	0	0	0	0	37	0	111	12
210	0	0	0	0	0	48	0	119	12
220	0	0	0	0	0	0	0	102	13
230	0	0	0	0	0	0	0	97	13
240	0	0	0	0	105	0	0	85	15
250	0	0	0	0	111	0	0	78	15
260	0	0	0	0	163	183	10	78	15
270	0	0	0	0	128	148	15	77	19
280	0	0	0	0	107	113	28	77	320
290	0	0	0	0	84	89	30	75	270
300	0	0	0	0	70	80	21	77	245
310	0	0	0	0	66	74	21	85	217
320	0	0	0	0	65	76	25	88	198
				0	63	67	67	108	108
			137	66	69	70	122	99	
				148	69	78	73	0	22

You may have these already available. If not, one of the easiest ways it to open Google Earth and use the ruler tool to measure out distances.
In the image below, the red arrow indicates where the ruler tool is. Once this is turned on, click and let go on the map at the coastline near your fore-cast point. As you move the mouse, the info box (red circle) will show the length of the line. The latest version of Google Earth shows the angle (heading) as well...but older versions do not.

Once you check for fetch tables and add sites if necessary, go back to the Config tab and click on the Get Fetch Tables button. Note: You need to click the Get Fetch Tables whether or not you had to manually add a site.

You wont see anything change on the config tab, but if you go to the FetchTables tab, they correct ones should now be there.

Go back to the FlowChart tab and save!

You may choose to edit fetch tables during a winter season if ice coverage is cutting down on fetch. If you choose to do this, make the changes in the FetchTables tab, so your standard tables remain unchanged in the FetchWork tab for later. You also may just want to have the user edit the fetch manually on the FlowChart tab when using the program.

Google Earth